Sangam SKM College – Nadi

Lesson Notes: Week 1

Year 11

Physics

Strand	**Energy**
Sub Strand	Work
Content learning outcome	At the end of the lesson, students should be able to define work and power and identify components of work by explaining the relationship between work and power through using of formulas to calculate work and power.

What is energy?

The simplest definition of energy is "the ability to do work". Energy is how things change and move based on transmission factors. It takes energy to cook food, to drive to school, and to jump in the air. Generally we have different forms of energy as it takes a number of different forms. Energy is a scalar quantity and the standard unit of measure for energy is the joule which is abbreviated as J.

Work done by a constant force

Work is defined as the rate at which energy is transferred from one form to the other.

- Work done on an object along a given direction of motion is equal to the force times the parallel displacement.

$$\boldsymbol{Workdone = Force \times displacement}$$

$$\boldsymbol{W = F \times d(parallel)}$$

Where work done is in joules and force and displacement have their usual units

- No work is done along a direction of motion if the force is perpendicular.

Example 1:
If Sam pushes a table with a force of 10 N to move a box that travels 2 m in the direction of his push, the amount of work done will be?

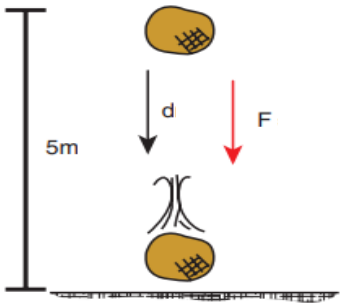
$$W = F \times d$$

$$= 10\ N \times 2\ m$$

$$= \mathbf{20\ J}$$

Example 2:

An object of mass 2 kg falls with a force of 20N from a height of 5 m to the ground. What is the work done by the object?



Displacement = 5m force = 20N

Work done = force × displacement (parallel)

= F × d

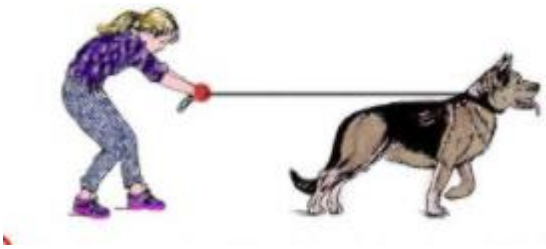
= (20N) × (5m)

= **100J**

Exercise

1. Raymond pushes a box of 35kg along the surface of frictionless surface with a force of 400N. If the distance moved while pushing the box is 5m then calculate the work done by Raymond in pushing the box. (*leave 4 lines for working)*

2. A dog pulling a 20-kg child-sled combination across a horizontal snowfield accelerates from ***rest*** to a velocity of 5 m/s over the course of 5 seconds with an acceleration of 1 m/s^2



How much work does the dog do on the child-sled combination? Assume friction is negligible.

(*Leave 4 lines for working)*

Hint: ***(Use equations of motion to find distance travelled first whereby force can be calculated using Newtons 2st law.)***

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Lesson Notes - Week 2

Year 11

Physics

Strand	Energy
Sub Strand	Power
Content learning outcome	At the end of this lesson students should be able to conceptualize the fundamental difference between work done and power with their respective formulas.

What is Power?

Power is the rate at which energy is transferred from one form to the other. Generally it is quantity that has to do with the rate at which a certain amount of work is done. It however remains a scalar quantity having the SI unit as Watts (w) or can also be expressed as J/s.

$$\boldsymbol{power = \frac{workdone}{time}}$$

$$\boldsymbol{p = \frac{w}{t}\ or\ \frac{F \times d}{t}}$$

Example 1: Suppose that Ben Affleck lifts an object of 800N upwards with a height of 2 meters in 1.8 seconds. Calculate the power rating.

- *The work done will be $W = F \times d$ = (800)(2) where the time is given as 1.8*

$$p = \frac{w}{t} \qquad p = \frac{(800)(2)}{1.8}$$

$$\boldsymbol{= 888.89\ watts}$$

Example 2: A tired squirrel (mass of approximately 1 kg) does push-ups by applying a force to elevate its center-of-mass by 5 cm in order to do a mere 0.50 Joule of work. If the tired squirrel does all this work in 2 seconds, then determine its power.

- *We already know the work done (0.50 J) in this case in which time is 2 seconds.*

$$p = \frac{w}{t} \qquad p = \frac{0.5}{2}$$

$$\boldsymbol{= 0.25\ watts}$$

Activity

1. A 64 kg student travels from the first floor to the fourth floor of a school (a height of 15 m).

    a. What total work did she do climbing the stairs?

    b. How long would this trip last if the student produced 240 W of power?

2. Jacob who has a mass of 60-kg runs up the stairs 10 meters high in about 2 minutes.

    a. Convert 2 minutes into seconds.

    b. What would be the weight force of Jacob at a height of 10m?

    c. Calculate the work done by Jacob *(use force from part b).*

    d. Determine the power.

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Lesson Notes - Week 3

Year 11

Physics

Strand	Energy
Sub Strand	Forms of Energy
Content learning outcome	At the end of this lesson, students should be able to verify and commiserate with different forms of energy.

Forms of Energy

In the context of physical sciences, several forms of energy have been identified. The different types of energy include thermal energy, radiant energy, chemical energy, nuclear energy, electrical energy, motion energy, sound energy, elastic energy and gravitational energy. However our focus remains only at five different forms.

1. **Mechanical energy:** Mechanical energy is the energy that is possessed by an object due to its motion or due to its position. Mechanical energy can be either kinetic energy (energy of motion) or potential energy (stored energy of position).

   Example: A barbell lifted high above a weightlifter's head possesses mechanical energy due to its vertical position above the ground. A moving baseball possesses mechanical energy due to its high speed.

2. **Nuclear energy:** Nuclear energy is the energy in the nucleus, or core, of an atom. Nuclear energy can be used to create electricity, but it must first be released from the atom. In a nuclear reactor, atoms of uranium are forced to break apart. As they split, the atoms release tiny particles called fission products. Fission products cause other uranium atoms to split, starting a chain reaction. The energy released from this chain reaction creates heat which can be used to generate electricity.

3. **Radiant energy:** Radiant energy, also known as electromagnetic radiation (EMR), is energy transmitted without the movement of mass. Practically speaking, this is the energy found in electromagnetic waves, also known as light. Light is made of individual particles called photons, each carrying a small "packet" of energy. Solar power harvests radiant energy carried by the light from our sun by converting it into electricity.

   Example: Examples of radiant energy include the warmth that radiates (transfers) from a hot stove and the warmth from direct sunlight

4. **Electrical energy:** Electrical energy is the most convenient form of energy for most human uses. The energy itself is held in the movement and configuration of electric charge. The flow of electric charge (usually electrons) is electric current. Charge usually builds up on a device called a capacitor which in turn stores electrical energy. This energy maybe used later for other services.
   Example: When you turn on a light switch, the light that fills your room isn't magic – it's energy! Electrical energy is produced by the movement of electrons along an electric current.

5. **Chemical energy:** Chemical energy is the potential of a chemical substance to undergo a chemical reaction to transform into other substances. Chemical energy is energy stored in the bonds of chemical compounds, like atoms and molecules. This energy is released when a chemical reaction takes place. Usually, once chemical energy has been released from a substance, that substance is transformed into a completely new substance.

   Example: Some examples of storage media of chemical energy include batteries, food, and gasoline. When we eat food we tend to take in chemical energy which enables us to do move due to transfer of energy.

Activity

1. Research and discuss where your energy comes from that enables you to move and perform work.

2. Explain the five forms of energy in your own words.

3. Which of the energy forms is used widely in Fiji? Support you answer with an explanation.